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European Post-war Exports

A review of the Spanish technical Press throughout the war is very illuminating from the post-war business angle. In the early stages, it was interesting to notice the ever-increasing volume of German advertisements, until they assumed a dominating position. British and American industry made practically no effort to enter into competition with this flood of propaganda. After the invasion of the Continent, the tide began to ebb, and to-day only two classes of German advertisements remain. These are where the Germans have established branch factories in Spain, whilst still retaining wholly or in part the original name, and where the agents for the Huns still have stocks for disposal. Spain has long been a happy hunting ground for the German manufacturer, especially for the great electrical engineers.

When we worked in Bilbao during the last war we noticed that the majority of the departmental managers were pro-German, whilst the proprietors and workers took the opposite view. Buying capacity was largely in the hands of the former class, and the German agents were not backward in the application of "palm oil." The Huns were thus well placed, backed as they have been by the Ministry of Propaganda of the Nazi party to worm their way into Spanish industry. One method, that of technical Press advertisements, was expanded to include editorial support, and one prominent engineering journal invariably carried full-page translations of the D.I.N.—German official—specifications. These apparently have been adopted *holus bolus* by Spanish industry. They are now collected and are being published in a series of books for the "benefit" of Spanish industry. Judging from the reports of the British Ministry of Information, German industry, consequent upon the attentions of the allied air forces, is in pretty poor shape to undertake any export business, and this state of affairs will continue to operate for some years to come.

Realistic views must be taken of the Spanish attitude to the German specifications. Primarily they are presented in metric units; they are no way in advance of their British counterparts, and they have now been assimilated into Spanish practice. Their existence should be no bar to the supply of British material for the Spanish market. It may mean a measure of co-operation to permit the economic production of some articles to metric dimensions. What we have written about German penetration into Spanish industry no doubt applies with equal force to other European countries, and we feel that the Continent is to be a much more important market for British goods than has been the case for some decades. Nearly all the oldest locomotives in the predominantly agricultural countries of Europe are British, whilst the latest models come from Germany. This is a particularly bad advertisement, but one which can be easily neutralised by a modern publicity approach.

From the British angle, the manufacture of prime movers and heavy engineering products in general is one which can be undertaken fairly quickly without interfering too seriously with the national rebuilding projects as a different set of raw materials and a separate class of artisans are utilised. The two are complementary. There will be much hard spade work to be done during the next decade to divert from European countries orders of a type which has been virtually a German monopoly for years. The effort is well worth making now, as its success will contribute in no small measure to the economic balancing of British manufacturing facilities.

THE WHITING CORPORATION, of Harvey, Ill., has recently celebrated the 6th anniversary of its establishment.

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NOTES FROM THE BRANCHES

FALKIRK SECTION.—The annual general meeting was held at Falkirk on March 2. The secretary, Mr. T. R. Goodwin, was unanimously elected President of the Section for the next session, in token of the work he had carried through for the Section over the past eight or nine years. The new President is works chemist and metallurgist with Smith & Wellstood, Limited, Bonnybridge, with whose Executives' Club he has held the post of secretary since its inception. Mr. Goodwin will continue as secretary of the Section after his period of office has ended.

After the normal business had been conducted, the retiring President, Mr. R. R. Taylor, of Larbert, announced that members seemed to have been shy of bringing their troubles forward to the Casting's Inquest, so that it had been decided to substitute a "Hat Night." This proved to be very acceptable, as the first question raised such interest that further contributions had to be held over for a later meeting.

The question was asked by Mr. John A. Donaldson, and was as follows:—"What steps can be taken to popularise moulding as a career?" Various remedies were suggested. Some members thought that the monetary incentive was insufficient, while others were of opinion that the dirty conditions in most foundries were the greatest drawback. The chairman expressed the view that the natural mistrust between employer and employee seemed to retard progress in that direction, but the bulk of the audience offered reasons which could safely be said to be certain of correction, when the Factories Act came fully into practice again. The present educational system, including continuation class work, came in for a modicum of criticism, while the secretary suggested that greater opportunity should be given apprentices to follow the casting they were making, through its foundry journey to the stage where it left for the customer, especially in factories where it was but one of the components of a particular unit.

WEST RIDING OF YORKSHIRE BRANCH.—The first meeting in connection with the S. W. Wise Memorial Prize was held on March 10, at the Technical College, Bradford. The award was divided between Mr. W. Peacock, of Leeds, and Mr. W. Jones, of Bradford, for their Papers, "Methods of Production in the Post-war Foundry" and "The Modern Specialised Foundry." Mr. Jas. Timbrell, senior vice-president, who presided in the absence abroad of the President, Mr. J. Blakiston, in announcing the award, said the meeting was historical for the Branch. Due to the initiative and generosity of the members, a fund was now available to provide an annual monetary award for the best Paper or Papers submitted. This meeting would serve to emphasise the warm appreciation the Branch felt for the late Sidney Wise, whose interest in the Institute and the Branch was paramount among his activities throughout his long and useful secretaryship. Congratulating the two young men on

(*Continued at foot of next column.*)

INCREASING FATIGUE STRENGTH BY SHOT BLASTING

Mr. Edwin Laird Cady has contributed an interesting article to "Metals and Alloys" on the "Blast Treatment of Metals for Cleaning and Peening." It is under the heading of peening that the following information is disclosed.

The surface peening application, now engaging the attention of a growing number of engineers and production men, represents a major contribution to strengthening the surface and thereby improving the life of parts subjected to vibration service or "fatigue." Shot peening is simply a cold-working operation that produces a shallow layer of surface metal which is harder, stronger and less ductile than the underlying metal. The chief advantage of shot peening is that through the formation of this surface layer of metal in a state of compressive stress, it increases the "fatigue strength" or "endurance limit" (resistance to cracking or breaking in repeated-stress or vibrational service) of the part and either lengthens its life or permits the use of heavier fatigue-loads than can be used with unpeened parts.

To a certain extent shot peening can replace heat-treating or surface hardening if distortion must be avoided. It is being applied to finished parts, such as springs to specific areas (*e.g.*, fillets) on structural or machine parts or to the body of a shaft to resist pitting corrosion or "corrosion-fatigue." Shot-peened gear teeth have improved resistance to pit corrosion and to wear. It has also replaced polishing, for shot blasting has long been used for cleaning parts and the blast intensities used for peening have a distinct polishing effect.

The effect of shot peening on the fatigue strength of various metals is given in a table, not reproduced, which shows gains in strength ranging from 0 to 100 per cent.

(*Continued from previous column.*)

their efforts, the chairman called upon them to read their Papers.

Blackboard diagrams and lantern slides added interest to the various points covered. After a prolonged discussion, a vote of thanks, proposed by Mr. Stott and seconded by Mr. Hodgkinson, concluded an interesting evening. The adjudicators for this year's competition were Mr. W. G. Thornton, Mr. D. W. Hammond and Mr. Jas. Timbrell.

NEWCASTLE-UPON-TYNE.—The fifth meeting of the session was held at Newcastle on March 17, and was as well attended and as successful as the forerunners. A Paper, exceptionally well illustrated by lantern slides, entitled "The Operation and Maintenance of the Hydro-blast Plant," was read by Mr. H. G. Goyns.

METALLURGICAL ASPECTS OF MACHINE-TOOL CASTINGS

Meeting the requirements of the engineer

By J. G. RITCHIE

(*Continued from page* 234.)

Phosphorus in cast iron forms a hard brittle iron-phosphide eutectic with a melting point of 950 deg. C., which is considerably below the melting point of the remainder of the iron. With low-phosphorus irons this phosphide constituent occurs as small isolated particles, but as the phosphorus increases it gradually tends to assume the form of a network. The phosphide constituent being hard and brittle, it is not surprising, therefore, that increasing phosphorus increases the hardness and decreases the toughness of the iron. It is found that with plain irons an increase of about 4 points in the Brinell hardness can be expected for every additional 0.1 per cent. of phosphorus. Thus, other things being equal, a 0.2 per cent. phosphorus iron might have a Brinell hardness of 180, and a similar iron with 0.7 per cent. phosphorus a hardness of about 200. This additional hardness obtained from the hard phosphide eutectic particles improves the resistance to the type of sliding wear found in machine tools.

On the other hand, high phosphorus tends to make an iron definitely more brittle, and the impact value is found to fall continuously as the phosphorus is increased. With tensile and transverse strength an increase of phosphorus from nil up to 0.3 to 0.4 per cent. produces some improvement in medium-strength irons, but with higher phosphorus contents the strength drops steadily. Generally speaking, the higher the tensile strength specified the lower must be the phosphorus content. This means that really high-strength irons must be low-phosphorus irons.

Because of the low melting point of the phosphide eutectic, phosphorus tends to lower the solidification point of cast iron, and high-phosphorus irons are, for this reason, more fluid than low phosphorus at the same temperature. The greater solidification range with the high-phosphorus irons can bring problems, however, with shrinkage and interdendritic porosity in heavy sections or at marked changes in section. A good deal of research work has been carried out in England on this point, and it has been shown that there is a definite relation between soundness and the phosphorus, total carbon and silicon contents of an iron. For each phosphorus increment the composition, as indicated by the total carbon and silicon, should lie to the left of the particular phosphorus curve. These curves strictly apply only to the particular type of dumb-bell test-piece used for the tests, but they are useful in showing that, with increasing phosphorus, it is necessary to decrease the total carbon and/or the silicon to secure soundness.

High phosphorus will improve wear resistance, reduce tensile strength and toughness, improve fluidity and increase the tendency towards unsoundness in heavy sections. It is desirable that all these qualities should be as high as possible in machine-tool castings so that it will be obvious that the final choice must be a compromise. The necessity for soundness probably imposes the principal upper limit on phosphorus content and in England about 0.6 to 0.7 per cent. phosphorus seems to be a normally accepted maximum. Where deep tee-slots have to be cut from the solid, a lower figure may be necessary. In Australia the tendency is generally to keep the phosphorus somewhat lower at round about 0.2 to 0.4 per cent. The figure actually adopted is also governed, of course, by the available grades of pig-iron. For this reason the phosphorus is generally inclined to be high in English castings owing to the relative scarcity of low-phosphorus pig-iron. The reverse applies here where the standard foundry irons used for most engineering castings are all low-phosphorus irons with 0.3 per cent. phosphorus maximum.

Specifications and Testing

The practice of ordering castings to a specification is undoubtedly spreading, and this will continue as further progress is made in producing irons of definite physical properties. Both the British and American specifications give a range of grades based on the tensile and transverse strengths on separately cast test-bars. In each case it is the physical properties which are specified and the chemical composition is rightly left to the discretion of the founder. The British standards are normally used in Australia, and these give six grades of iron covered by two specifications—B.S.S. No. 321 and No. 786.

Grades A and C represent low-strength irons which are produced with straight pig-scrap iron cupola charges and have fairly high total carbon (3.5 to 3.7 per cent.) and silicon (2.0 to 2.7 per cent.), and often also high-phosphorus contents. They are easy to cast in the foundry and no great degree of technical control is required in their production. The structure (in medium sections) consists of large graphite flakes in a matrix of ferrite and pearlite and the Brinell hardness would range between 140 and 180. Because of the coarser graphite flakes these low-strength irons possess better damping capacity than the very high-strength irons. These grades have not a high enough wear resistance for the vital wearing parts of a modern machine tool, but Grade A castings are quite

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suitable for lightly stressed parts, particularly with medium and thin sections. Owing to the relatively high silicon content, there is little danger of trouble with hard chilled corners or edges and the machinability is very good. Because of the improved capacity for damping vibrations, there is much to be said for making unstressed capacity such as trays, pedestals, legs and the like from a very soft iron.

Grades 1 and 2 of B.S.S. 786 are medium-strength irons with a structure consisting of medium-size graphite flakes in a completely pearlitic matrix. Medium total carbon contents (3.0 to 3.4 per cent.) are generally used, and this is achieved by the use of fair proportions of steel scrap in the furnace charge. The silicon is adjusted to obtain the desired pearlitic matrix and to avoid excessive chilling on the thin sections. The silicon generally ranges from 1.3 to 2.0 per cent., depending on the section and a phosphorus content up to about 0.7 per cent. can be tolerated for Grade 1. The completely pearlitic structure gives a Brinell hardness of 180 to 230 and good wear resistance. The medium-size graphite flakes permit a reasonable compromise between high damping and lubricating effect on the one hand and high surface finish and strength on the other. Although the castability is not as good as higher total carbon irons, the metal meeting these grades will "hold" quite well and is reasonably fluid provided it is tapped hot from the furnace. The necessity for tapping good hot metal for machine-tool castings cannot be overemphasised and it very materially assists in securing clean, sound castings. Because irons of Grades I and II combine physical properties with ease of handling in the foundry, they are almost universally favoured for heavy wearing machine-tool parts such as beds, tables and the like.

In many cases plain irons meeting these specifications are used, but low alloy irons are also very popular. Small nickel, nickel-chrome and graphitising additions materially assist in securing the desired completely pearlitic structure in heavy sections and both chromium and molybdenum definitely improve the wear resistance. The alloy additions must be balanced, however, to avoid any of the chilled corners and edges which are so unpopular in the machine shop. Thus, if a carbide stabiliser such as chromium is used, it generally needs to be balanced by a corresponding addition of a graphitiser such as nickel or silicon.

A combination turret lathe with the bed casting made of a medium total carbon low nickel-chrome cast iron gave a Brinell hardness of about 202 to 217 in a 2-in. section, and met the requirements of B.S.S. 786, Grade I or II. Iron of similar quality should be used for lighter section stressed parts such as the saddle and apron castings, and also for a heavy section such as the hexagon turret where good appearance is required on the machined surface. In some cases a small ferro-chrome addition can be helpful in securing the desired density in these turret castings. Lightly stressed parts of the machine, such as the pedestals, tray and guards, can be made of softer iron with a view to making use of its improved damping capacity. An 18-in. production milling machine, where once again a medium total carbon completely pearlitic iron is aimed at, gave a Brinell hardness of about 200 in the heavy sections. A good dense iron is particularly necessary for the table in order to prevent porosity at the bottom of the tee-slots, which are machined from the solid.

Improved Wear Resistance

The phosphorus can sometimes be taken up with advantage in order to secure improved wear resistance. For example, an 18-in. centre height all-geared head engine lathe with a 30-ft. bed required about 9 tons of metal to be cast and the metal had to be held up to 1¼ hrs. In this particular case the phosphorus was deliberately taken up to 0.62 per cent. to obtain better fluidity and improved wear resistance in the final casting. The composition was actually T.C, 2.9; Si, 1.3; P, 0.62; Ni, 0.7; and Cr, 0.25 per cent., which gave a Brinell hardness of 228 in a 2-in. and 241 in a 1-in. section.

An interesting point regarding lathes is the relative hardness which should be aimed at on the bed and saddle wearing surfaces. The saddle may traverse the whole length of the bed, and the wear is therefore concentrated on a smaller area in the former. If the saddle be made harder, however, the bed may wear and to regrind a bed is an expensive operation. It is generally considered, therefore, that the saddle should be a little softer than the bed, the argument being that when wear does occur, it is easier to repair a saddle than a bed. It might perhaps be as well to point out at this stage that usually conceptions of high-strength are based on tensile strength. All the standard specifications are based on tensile strength. Large machine-tool castings are, however, subjected to wear and compressive stresses, and it is very seldom that tension is involved. For this reason it should be understood that a very high tensile strength iron may not necessarily be so suitable as one with medium tensile and with the composition adjusted to give maximum wear resistance.

Coming on to the final two grades—3 and 4 in B.S.S. 786—one enters the field of true high-strength irons. These irons are generally made with high steel content charges in order to reduce the total carbon down to 2.8 to 3.1 per cent., and the silicon goes up over 2 per cent. in order to keep the metal grey. These irons are nearly always inoculated with graphitising ladle additions, such as calcium silicide, ferro-silicon, silicon, aluminium, nickel, etc., and for Grade 4 are generally alloyed as well. Because of the low total carbon the metal must be melted very hot, but it definitely tends to "go off" quicker than the lower strength irons. The shrinkage is also higher so that big risers must be used, and the general moulding practice approaches that of steel castings. These foundry difficulties, together with the reduced damping capacity and wear resistance due to the smaller graphite flakes, makes such high-strength irons not

particularly suitable for large machine-tool castings. They have a very definite application in medium and small highly stressed machine-tool parts such as gears, tool shanks, cams and the like. These irons can be considerably improved by heat-treatment.

In order to secure improved wear resistance on the wearing surfaces, it was common practice at one time to densen the ways of machine-tool castings with chills. Usually a soft iron was used, and the result was a close-grained surface backed up by an open porous structure. Theoretically this should combine high wear resistance and damping capacity in the one casting, but practical difficulties have caused this process to be gradually superseded. The chills are expensive to prepare, difficult to set and the cast surfaces often tend to be badly warped. This naturally results in setting up difficulties in the machine shop and irregular hardness due to removal of the densened surface to varying depths.

and quenching, and the hardness can then be reduced to any desired figure by tempering. The amount of hardening which can be achieved is dependent to a large extent on the structure of the iron. The function of heating above the critical range is to transform the pearlite to austenite, and this in turn changes to a hard constituent, martensite, on quenching. Pure ferrite, on the other hand, does not harden on quenching, and it follows that large areas of ferrite in a cast iron will not contribute appreciably to the hardness increase which can be obtained by heat-treatment. Thus, in machinable grey irons, to secure maximum increase in hardness with heat-treatment, the matrix of the iron should consist completely of pearlite.

Hardening is generally carried out by oil quenching from about 850 deg. C., and the highest Brinell hardness is secured in the "as-hardened" condition. The hardness falls off with tempering, but the tensile strength generally rises to a maximum with temper-

TABLE III.—*Hardness of Cast Iron After Annealing.*

Condition.	Plain Iron.*		Nickel–Chrome–Molybdenum Iron.†	
	C.C. per cent.	BHN	C.C. per cent.	BHN
"As cast"	0.69	217	0.70	255
Quenched from—				
650 deg. C.	0.54	207	0.65	250
685 deg. C.	0.38	187	0.63	241
703 deg. C.	0.09	170	0.59	229
732 deg. C.	0.09	143	0.47	217
760 deg. C.	Nil	137	0.45	197
785 deg. C.	0.05	143	0.42	207
826 deg. C.	0.47	269	0.60	444
843 deg. C.	0.59	444	0.69	514
871 deg. C.	0.67	477	0.76	601

* Plain iron: T.C. = 3.19 per cent., Si = 1.70 per cent.
† Alloy Iron: T.C. = 3.10 per cent., Si = 2.05 per cent., Mo = 0.45 per cent., Cr = 0.27 per cent., Ni = 0.37 per cent.

On the matter of testing, the British Standard cast bar gives no indication of how the properties of an iron vary with section—an important matter in machine-tool castings where maximum hardness in the heavy sections combined with absence of chilling in the light sections is sought. This point can best be checked by use of a stepped test-bar, the one the writer uses having 2-in., 1-in., ½-in. and ¼-in. sections. This is cast vertically with the heavy section uppermost. It is then sectioned and the Brinell hardness measured on the three thicker steps and the depth of chill on the tip of the ¼-in. section. One of these bars can be cast to represent each important casting. For furnace control small chill wedges offer the most rapid checking method and the results of these can be interpreted in the light of subsequent chemical analysis.

Hardening and Tempering

It has already been pointed out that the general metallic matrix of cast iron is similar to steel, and, for this reason, a cast iron will respond to heat-treatment in the same way as a steel. In other words, it can be hardened by heating to above its critical range

ing at about 350 to 450 deg. C. Generally, a low-temperature tempering at 200 to 250 deg. C. is always desirable to remove quenching stresses, and under such conditions a Brinell hardness of 400 to 450 can be secured in small castings. This naturally gives a much more wear-resistant material than the "as-cast" iron, or Brinell hardness about 200 to 220. It would be obviously too hazardous to quench large machine-tool castings, but heat-treatment can sometimes be of benefit in securing improved wear resistance on smaller parts—for example, cams.

Alloy irons are often to be preferred when heat-treatment is to be carried out. The first reason is because alloying elements such as nickel, chromium and molybdenum increase the hardenability or depth to which the iron will harden. This allows larger castings to be hardened in an oil quench than would be possible with a plain iron. It also permits a more uniform hardness to be secured through the heavier sections.

A second reason for preferring alloy irons for heat-treatment is that they show a much reduced tendency to graphitise during heating to the quenching tem-

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perature than plan irons. It has been found that the pearlite in grey iron tends to graphitise very rapidly just below the critical range and the graphite is apparently re-dissolved at higher temperatures. Figures (Table III) published by Timmons, Crosby and Herzig[45] illustrate this point, and it will be noted how the combined carbon falls to nil at 760 deg. C. and then rises at higher temperatures due to re-solution of the graphite. The important point to note is that the nickel-chrome-molybdenum iron is much less susceptible to this graphitisation than the plain iron.

It will be noted that a very low hardness is reached, due to graphitisation on quenching the plain iron from 732 to 785 deg. C. This graphitisation apparently occurs extremely rapidly, and will take place even with the short time involved in flame hardening. Table III shows that the hardening temperature should be at about 850 to 860 deg. C. to ensure adequate resolution of the graphite.

It would be dangerous to attempt to improve the wear resistance of large machine-tool beds by quenching, but it is possible locally to harden the wearing surfaces. This is actually carried out by one or two overseas machine-tool manufacturers who flame-harden their lathe beds. In order to assist in securing uniform high hardness, and also to prevent a soft layer due to graphitisation between the hard surface and the core, one maker[46] uses castings of the following composition:—T.C, 2.80 to 3.20; C.C, 0.75 to 0.55; Si, 2.0 to 1.7; Mn, 1.0 to 0.7; Ni, 1.5 to 1.0; P, 0.15 (max.); and Cr or Mo, 0.25 per cent. (max.).

The beds are immersed in a water tank up to the underside of the shears and a carriage carrying six heating torches followed by quenching jets moves along the length of the tank at a predetermined rate. The surfaces are hardened to a depth of ¼ to ½ in. (surface hardness = 580 Brinell) and finally ground to remove the slight warp which takes place. The makers of such machines claim that wear tests have shown that the flame-hardened bed wears very much better than an unhardened iron.

Stress Relieving

When a mould is cast, the various sections solidify and contract at different rates and free contraction is prevented. As a result the final casting is in an internally stressed condition. On machining these stresses tend to be relieved and movement occurs. This movement may go on over a considerable period and may in some cases seriously affect the accuracy of the finished part. The internal stress in a casting is concentrated mainly in the skin and maximum movement occurs when the skin is first broken in machining. To overcome troubles due to movement, the practice of seasoning or weathering of castings was introduced. The procedure was to rough-machine the castings and then subject them to a weathering period of up to 12 months, during which time they would be subjected to extremes of atmospheric temperatures. A further relief of stress occurred during this weathering period, although the major relief almost certainly took place during rough machining.

It is obviously not practicable with modern machine-tool production to use such a time-consuming process, and this classical weathering or seasoning treatment is not used by overseas manufacturers to nearly the extent indicated by popular belief. In most cases with large castings, it is the practice to rough-machine first, then relieve all clamps and fastenings on the job and to set up again before going on to finish-machine. This procedure allows most of the stress to be removed in rough-machining. A casting may then stand for several weeks prior to final scraping or grinding, and further relief probably occurs in this period. For many machine-tool castings a procedure of this nature gives a sufficiently low internal stress for all practical purposes.

There are certain machine-tool parts, however, where it is essential that there should be no possibility of movement whatsoever. For such cases a low-temperature, stress-relieving heat-treatment can be used and almost complete stress relief can be achieved. A good deal of research work has been carried out to determine the effect of temperature on stress relief of cast iron. The procedure is generally to use a specially shaped test casting which will show definite movement if cut at a stressed section. From the amount of movement the internal stress can be calculated. Using a procedure of this type, it has been found that the effect of annealing temperature on stress relief is as follows:—

Annealing Temperature	Stress Relief, per cent.
100 deg. C.	nil
200 ,,	3
300 ,,	12
400 ,,	33
500 ,,	60
550 ,,	92
600 ,,	100

It is emphasised that these results only apply if there is adequate soaking time at the annealing temperature followed by very slow cooling. With cast iron there is another effect to be considered, and that is the breakdown of iron carbide to graphite. In a grey iron reliance for wear resistance is placed on obtaining a matrix consisting completely of pearlite—which is a mixture of iron carbide (cementite) and iron (ferrite). If such a structure is heated in the range 500 to 700 deg. C., the iron carbide tends to first coalesce and then to break down to graphite. Such a charge softens the iron and seriously impairs the wear resistance. At 500 deg. C. this change is very slight, but at 600 deg. C. the loss of hardness is appreciable.

In deciding on a stress-relieving temperature, therefore, it is necessary to compromise. If the casting is annealed at 600 deg. C. and 100 per cent. stress relief secured, the casting will be softened, and for vital machine-tool parts it is generally better to maintain the hardness and accept about 60 to 90 per cent. stress relief, which is generally sufficient. For this reason

stress relieving is generally performed in the range 500 to 550 deg. C. On the basis of the above information a suitable stress-relieving heat-treatment cycle for small castings might be as follows:—(1) Heat castings slowly up with furnace to 500 deg. C. Heating rate about 50 deg. C. per hr., and load reaches temperature in 10 to 11 hrs. (2) Soak for 12 hrs. at 500 deg. C. (3) Cool very slowly. About 30 deg. C. per hr. and total cooling time may take up to 40 hrs. This is a very lengthy treatment, but if any attempt is made to rush it, the desired stress relief may not be achieved.

Acknowledgments

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FORMULA FOR METAL POLISH

In the formulation of metal polishes and cleaners, soap serves as a cleansing, a "wetting" and an emulsifying and stabilising agent. Here is the formula for a typical paste polish:—Chip soap, 10 parts; silica dust, 20 parts; air-floated tripoli, 20 parts; pine oil, 2 parts; water, 48 parts.

Dissolve the soap in the hot water and add the previously mixed silica and tripoli without stirring; then add pine oil, with stirring, and run the hot mixture into suitable containers. The abrasives, silica and tripoli should be able, almost 100 per cent., to pass through a No. 325 sieve.—*F. W. Smither, National Bureau of Standards, in "Metals and Alloys."*

MR. GILBERT LAURIE ANDERSON, a retired iron-founder, of Falkirk, died recently.

THERE ARE THREE WAYS in which to overcome possible cold-processing difficulties that might be experienced with silicon-manganese spring steel, says R. G. SARTORIUS, writing in the "Iron Age": (1) Heating to an elevated temperature (54 deg. C. to 82 deg. C.); (2) stress relieving (649 deg. C., water quench); (3) full annealing. Full annealing without graphitisation, says the author, should be of interest to those engaged in the cold-drawing or rolling of silicon-manganese steel.

BOOK REVIEW

"Steelplant Refractories." By J. H. Chesters. Published by the United Steel Companies, Limited, Glossop Road, Sheffield. Price 36s.

The choice of a title for this book strikes one as being an acceptable compromise between the normal English expression "steelworks" and the corresponding American phrase "steel mills." As the Author is equally well known in the two countries, there is certain to be on both sides of the Atlantic a large demand for this book, and it can confidently be stated that it will be generally accepted as the standard work of reference on the subject for many years.

Since the advent of X-ray examination, to which the Author has so successfully directed his energies, the general behaviour of refractories is now so much better understood as to render earlier books somewhat *démodé*. There is a sub-title to the book—"Testing, Research and Development"—and this connotes not only the contents of the book, but also the spirit which has animated its production.

In the chapter on testing no fewer than 14 methods are detailed and, so far as can be seen, to have a true appreciation of the quality of a cupola brick, the results from the whole of them should be available. However, generally speaking, as an item in iron-foundry costs, cupola bricks are nothing like so important as steelworks refractories, where it is stated a cost of 5s. per ton of steel produced is deemed normal. A fifteenth test omitted by the Author, but still useful, is dimensional perfection.

Naturally silicon is given pride of place as a refractory, and the chapter devoted to it gives a new, yet satisfying, appreciation of its existence in nature, its allotropic modifications, and its reactions with other oxides. In the pictures on page 61, which show results from the relatively new technique of X-ray testing, three types of ganister are illustrated, and the patterns revealed can undoubtedly better be related to practice than chemical composition. Next the Author has covered magnesite—a refractory still foreign to the foundry industry, except that portion of it devoted to the manufacture of steel castings, but for the second of the leading basic refractories—dolomite—general interest has recently been aroused through the researches of Renshaw and others.

Quite early in this study a proper appreciation of "stabilisation" is given, which is distinctly helpful. Later there is much useful information on the use of serpentine for this purpose. The relative new process of manufacturing dolomite bricks is described in some detail. The chromite bricks are also not much used in foundry practice; however, the alumino-silicates covered by Chapter VI are in the form of bricks as the mainstay of the industry, for they are used in most of the melting, heat-treatment furnaces and drying stoves, and, in general, are only subject to duties which they well withstand. The final chapter is this section is a very useful one on insulation, covering as it does the occurrence of Kresilguhr and its manufacture into bricks.

The balance of the book—more than half takes the subject right into the actual works and deals with the behaviour and proper use of refractories in the basic and acid open-hearth plant, the Bessemer converter, and the electric furnace. The book is rounded off with chapters on soaking pits and reheating furnaces and the casting pit. The reviewer has only one suggestion to make for the improvement of future editions of the book, and that is where pictures are divorced from the text, *e.g.*, Fig. 17, by a number of pages, a reference to their location should be inserted. All manufacturers and users of refractories should add the book to their libraries. V. C. F.

STANTON IRONWORKS' TRAINING SCHEME

The outstanding feature of this scheme, which is detailed in a 45-page brochure, is the incentives which are given to the boys taking the trade apprenticeship course. For instance, those specialising in either patternmaking or foundry practice can sit for the Wilson scholarship, which will take the winner to the British Foundry School. Entrants will normally be expected to have gained certificates in the final examinations in one of these subjects organised by the City and Guilds of London Institute.

Again, there are bonuses, paid weekly and continued until the apprentice comes of age, for those who obtain the City and Guilds' certificates and, finally, the best all-round apprentice each year receives the Stopes' prize, which, in addition to the receipt of a cup, enables the winner to spend a year in another section of the Stanton works or at Stewarts and Lloyds. Then there are courses for the special apprentices, where a training of the highest grade is promised, as these lads are destined for executive positions.

The brochure is illustrated with 22 pictures taken in the various workshops and laboratories.

NEW CATALOGUES

Foundry Specialities. Foundry Services, Limited, of Long Acre, Nechells, Birmingham, 7, have prepared a 12-page catalogue covering a wide and diverse range of products. These "Foseco" products, as they are known in the industry, where they relate to fluxes and the like, are sold in the form of large size pills. Though of a proprietary character, their composition is, we believe, available to users. The catalogue is divided into seven sections, and lists preparations for the heavy non-ferrous alloys; aluminium alloys; iron, zinc, lead, tin and white metals; magnesium; castings in dies, moulds and the like, and finally tools, spray guns, accessories and the like. Thus there is listed as comprehensive a list of services which is almost unique in its field.

High-frequency Furnace Cables. A footnote in a leaflet on Radio Frequency Cables, issued by British Insulated Cables, Limited, of Prescot, Lancs, refers to the development by the company of a line of cables designed to meet the needs of users of high-frequency melting furnaces.

PROSPECTS FOR PRINCIPAL CAST METALS*

By DONALD J. REESE

During 1944 the ferrous section—steel, malleable, grey iron—of the foundry industry melted approximately 23 million tons of metal. During that year this section of the industry was under continual pressure to meet military and critical civilian requirements. Up to the present time this pressure has not lessened, and current forecasts for 1945 indicate increasing requirements.

The foundry industry's No. 1 problem has been, and is, man-power. Its man-power problem is more acute than that of most of the metal industries, not only because its best workers have been taken into the services while others have been attracted to the glamour industries, but also, in a real sense, because it was not recognised early in the war that some of the materials processed in the foundry industry were needed to fight and win a war. With curtailment of civilian production of automobiles, farm and railway equipment, etc., the major part of the foundry industry suffered a business lull until the essentiality of its materials was recognised. During the early part of 1942 the malleable foundry industry declined to 30,000 product tons per month. During 1944, however, these same foundries were struggling to reach a 100,000-product-tons-per-month performance, with a backlog of up to 540,000 tons and an actual performance, in the last three months of the year, of 80,000 tons. During the business lull they lost man-power to other war industries.

During 1944 the foundry industry suffered considerably from unfavourable publicity. It was labelled with such terms as "hot," "heavy," "dirty," "onerous," and "low paid." Working conditions in the foundry industry are on a par with other metal industries. Generally, the foundry industry could improve its housekeeping, while its working conditions are not always as attractive as they might be. However, the foundry with the most favourable working conditions has had no less a man-power or absenteeism problem than the average. Generally, the wages in the foundry industry compare favourably with those of other long-time industries in the same area. The industry is not only anxious to correct its weak spots, but has a sincere desire to be one of this country's respected industries for another hundred years.

The foundry industry is seldom a main contractor and frequently is a sub-sub-contractor. Since it turns out many millions of component parts each month for this country's war and peace production, it is difficult to determine whether some less essential part is in production while some more important part is not; and, of course, scheduling errors made at any level above the foundry reflect a loss of production while a change to the required part is being effected.

Order Out of Chaos

The Controlled Materials Plan brought considerable order out of chaos, but the plan was limited to steel, copper and aluminium. It is unfortunate that the term steel was not broadened to include iron and steel, as this would have included grey iron and malleable iron, and possibly would have directed more effort toward establishing real requirements and to the putting of first things first.

For generations the foundry process of manufacture consisted of pouring molten metal into refractory sand moulds. For some years now the industry has been working on its moulding technique to achieve dimensional accuracy in the component parts produced by the industry. Here reference is made to the use of metal (permanent) moulds, air setting cement bonded silicon sand moulds, the Fisher process, investment moulding (lost-wax process), etc. Certain centrifugal casting techniques also achieve high dimensional accuracy, but the utility of this development aims to improve the material as well as certain founding procedures.

To the best of personal knowledge, no one knows the dollar value of the products of the overall foundry industry. During 1944 it probably approached 3 to 3½ billion dollars (say, 750 to 875 million pounds). The industry employs approximately 400,000 to 450,000 people.

The following production was achieved in 1943 and 1944 for cast steel, grey iron, malleable iron, aluminium and magnesium.

Product	Product in Short Tons	
	1943	1944
Grey Iron	10,000,000	10,000,000
Steel	2,740,000	2,450,000
Malleable	850,000	900,000
Aluminium	230,000	258,000
*Magnesium	33,000	39,000

* Excludes incendiary bomb production.

These figures are from published War Production Board data, except for personal minor adjustments and some extrapolation from monthly production to an annual basis. A personal attitude towards engineering metals is limited to the desire that the most suited material be selected for every use and that the selection be made by one completely informed on all the materials that warrant consideration.

Even during wartime, when many of its normal uses are drastically or completely curtailed, grey iron ranks as an engineering material second only to steel. When the steel industry reports production of 89.4 ingot

* Condensed from a Paper presented at the War Production and Future Planning Conference of the Engineering Societies on War Production in New York City, January 30, 1945. The Author is Chief, Manufacture and Foundry Products Section, Metallurgical and Conservation Branch, Steel Division, War Production Board, Washington, D.C. (on loan from the International Nickel Co., Inc., New York City), and a member of the Technical Committee, Gray Iron Founders' Society.

Prospects for Principal Cast Metals

tons, a comparable figure for grey iron at the same stage in manufacturing operations is 15 million tons. At the stage of assembly of these materials into finished machines, the comparison is more favourable to grey iron.

Grey iron is a generic term covering a whole family of ferrous alloys, and there can be considerable dissimilarity between one grey iron and another. For instance, the tensile strength of one type of grey iron may be 8.5 tons per sq. in., while that of another may exceed 43 tons. Grey iron is also an oddity in the family of metals in that its chemistry is designed in relation to the sectional dimensions of the part to be produced.

Assuming a 1-in. section is being computed for suitability, with a further assumption of a 13 tons per sq. in. ultimate strength and a factor of safety of 5, that is, with a unit stress of 2.6 tons per sq. in., but the load is 5.3 tons. Can the engineer double the section and still expect a material of 13 tons per sq. in. tensile? In most cases the same type of iron from any one source of supply would be used in making the 2-in. section as was used in making the 1-in. section, and the ultimate strength would be less than 13 tons per sq. in., unless the specifications made it clear to the producer that design was based on 13 tons per sq. in. in 2-in. sections. To achieve this in the foundry, the chemistry of the iron would be designed for 2-in. sections instead of for 1-in. sections. A recommended method, however, would be to maintain the 1-in. section and specify a 26-ton-per-sq.-in. iron.

Factor of Safety

When designing, the engineer avails himself of published data on the material and divides this data by his factor of safety (sometimes called the "ignorance factor"), which for grey iron is some number between 5 and 10. In addition to allowing a generous safety factor, the engineer also is reluctant to accept data on grey iron and uses the lower values of his reference. Much design utilising grey iron is based on 11 tons per sq. in. ultimate strength, which, with a safety factor of 10, results in a 1.1-ton-per-sq.-in. unit stress. If the factor of safety were 2.5 instead of 10 and the quality of iron 26 tons per sq. in. instead of 11 tons, the unit stress for design might be 10.7 tons per sq. in. instead of 1.1, or about 10 times greater.

Currently, a nationally known pump and compressor manufacturer is subjecting grey-iron parts to destructive testing; and on the testing done to date, failure occurs with a factor of safety of 1 at the previously determined ultimate strength, which, in this case, is approximately 17.8 tons per sq. in. Currently, one American nationally known Diesel engine manufacturer is producing the same size engine block in grey iron and in a welded steel fabrication. The finished weight of the grey-iron block is about 10 per cent. less than the finished weight of the fabricated block. Both blocks are intelligently designed for the specific methods of manufacture and for the materials of construction. The grey-iron blocks have been tested to destruction by the engineers, who were startled to learn that the stresses induced in destructive testing were many times the unit stresses used in design.

Unless weight is desired in the finished machine, grey iron presents a real challenge to the design engineer. Some foundries have considerable "know how," while others have too little "know how"; and the problems concerned with quality are not of material, but of a capable producer.

Strength-Weight Ratio

Grey iron weighs 0.26 lb. per cub. in. The tensile strength per unit of area divided by the weight per unit of volume might range between 80,000 and something greater than 320,000. Not long ago manufacturers of grey-iron piston rings for aircraft engines guaranteed their material at a minimum of 18 tons per sq. in. tensile. Currently they are guaranteeing a minimum of 40 tons per sq. in. Average performance must be somewhat better than the guaranteed minimum and the strength-weight ratio in this case approaches 400,000.

Ductility

The engineer wants data on "elongation" and "reduction in area," even though these data are not used in design calculations. Usually the numerical values required for this abstract data greatly exceed the maximum use of these properties in a machine under any condition of use or abuse. Grey iron has been considered a brittle material, yet it has a measurable, though small, elongation of the order of 1 per cent.

Grey iron is considered to have only slight resistance to impact. Up to the present time no standard test method has been adopted so that impact data for grey iron may be compared with other materials. However, considerable impact testing is done on this material by drop testing, repeated drop testing, and modifications of Charpy and Izod methods. For instance, a 1.125-in. dia. machined bar, broken on 6-in. centres, may show an impact resistance of 20 to more than 120 ft.-lbs. for the various types of grey irons.

Young's Modulus of Elasticity

This value for steel, generally taken as 28,000,000 to 30,000,000, may range from 12,000,000 in one type of grey iron to more than 20,000,000 in another type. One expects Young's modulus of elasticity to be constant for a homogeneous material. but grey iron is a heterogeneous material and Young's modulus will vary with heterogeneous variations of the material.

Fatigue Life or Endurance Limit

Many thousands of tons of grey-iron crankshafts have been used in large internal combustion engines and in other reciprocating machinery within the past five years. The endurance limit of grey iron should be parallel to the tensile strength at a point close to 0.45 times the tensile strength. Design of these parts is based on a minimum endurance limit of 25,000 tons

(*Continued on page* 260, *col.* 2.)

IRONFOUNDERS' NATIONAL CONFEDERATION

ANNUAL MEETING AND REPORT

As briefly reported in our last issue, Mr. Arnold E. Pearce, of the Midland Motor Cylinder Company, Limited, of Smethwick, has been elected president of the Ironfounders' National Confederation, with Mr. D. Graham Bisset, of the Enfield Foundry Company, Limited, Waltham Cross, as vice-president. In addition to the members of Council detailed last week, the following presidents of the I.N.C. Local Branch Associations are *ex officio* members:—Mr. T. A. Clapham, of Clapham Bros., Limited, Keighley; Mr. S. G. Harrison, of Sykes & Harrison, Limited, Ancoats; Mr. L. J. King, of Glow-Worm Boilers, Limited, of Milford; and Mr. James Mitchell, of Mitchell, Russell & Company, Limited, Bonnybridge.

Annual Report

The report, which was approved, is abstracted below.

In comparison with former years, when a subject like concentration occupied the interests of the members almost to the exclusion of anything else, the past year has been one of quiet, steady progress and improvement in the organisation of the industry in many different directions. It has seen the happy solution of some of the outstanding problems. Other extremely important matters have been receiving the earnest consideration of committees throughout the year, and are now approaching finality.

Membership.—A survey of the membership of the I.N.C. and of the constituent associations of the Council of Ironfoundry Associations clearly indicates that the very large majority of the responsible firms in the industry are now within the organisation. There are, however, a number of firms who produce castings for incorporation in their own finished products who still fail to realise that they are essentially members of the ironfounding industry.

The Iron Federation.—The formation of an Iron Federation was envisaged in the annual report for last year. Since then, numerous meetings have been held among all the interests concerned. After protracted negotiations, the Council of Iron Producers has been successful in obtaining the adherence of nearly all the producer associations and a constitution has been agreed. The formal announcement of the setting up of the Iron Federation cannot now be long delayed.

Post-war Reconstruction.—Members have made their returns to a very carefully worded *questionnaire* on the post-war requirements of the industry, and their replies have been embodied in a comprehensive memorandum which has been submitted to the Ministry of Supply. The Industrial Supplies Department of the Board of Trade has offered assistance to manufacturers who wish to undertake work on prototypes or similar work for post-war production and, providing firms can undertake such work without undue interference with the war effort, every facility will be granted to them.

The Ministry of Supply are preparing a priority list of firms that will, on the cessation of hostilities, require to spend sums of money to cover deferred repairs and replacements occasioned by five years of war, and to carry out schemes of modernisation and development. Members have been asked to make their returns accordingly. The question of the disposal of Government-owned and subsidised plant is under consideration. Representations under this head have been postponed, as a Committee was recently appointed by the Ministry of Supply to consider the whole question.

Education.—The important subject of the attraction of the proper type of young man into the industry is one which has been constantly in front of the Education Committee. It is a notorious fact that one of the features which has mitigated against recruitment of apprentices has been the general amenities in foundries as compared with the conditions in other branches of engineering. Therefore, in addition to a bulletin regarding the education and workshop training of young foundrymen, a *questionnaire* has been issued on the working conditions in foundries, and it is hoped that all foundries will be induced to maintain conditions that reach a certain minimum standard.

An attractive pamphlet has been prepared showing in picture and in print the advantages of a career in the ironfounding industry. This will shortly be circulated to schools and to parents. Together with the issue of this pamphlet, arrangements have been made in certain districts for personal visits by parents and the boys themselves to witness the actual working conditions of the foundries. Negotiations are still on foot for the setting up of a degree course in ironfounding at Sheffield University, and the I.N.C. has given its support to the reopening of the British Foundry School at Birmingham.

Costing of Government Contracts

The I.N.C. noted with grave concern the desire of the Contracts Department to establish a common system of costing for the whole industry. It therefore joined with the Federation of British Industries in protesting against such schemes as the capital employed and turnover method of fixing profit margins. Representations were made to the Treasury through the F.B.I., with the result that it has been agreed that no universal method is applicable to the ironfounding industry and that each firm should deal individually with the Contracts Department.

Standardised Conditions of Sale.—While in some areas there may have been in the past certain defined and accepted conditions of sale developed through the custom of the trade, no attempt has heretofore been made to lay down standardised conditions of sale for the industry as a whole. At the instance of the I.N.C., the C.F.A. has now appointed a small Sub-Committee to draft basic conditions of sale which can be accepted by the whole industry.

Ironfounders' National Confederation

Technical Committee

Throughout the year the Technical Committee has been able to answer numerous inquiries for advice from individual firms, but it has now been decided for the future that such information will no longer be available, and the Technical Committee will confine their work to questions affecting the whole industry. To this end, the membership of the Technical Committee has been greatly enlarged to include all the necessary interests. The terms of reference of this Committee are not circumscribed to purely technical matters, but will extend also to the consideration of wider issues, such as, for example, the means whereby the encroachment of substitute materials may best be combated.

Standardised Costing.—The Standardised Costing Committee, which is another Committee set up by the Council of Ironfoundry Associations, has met on frequent occasions throughout the year. At their early meetings they quickly realised the enormousness of the task which they had undertaken; consequently they have been unable as yet to issue a report. Their first report, however, is almost ready for production, and will have regard to the needs of the smaller firms who are unable to employ a competent accountancy staff.

Transport Advisory Panel.—This Panel is composed of the leading experts in the industry and has already issued four bulletins containing advice on problems of general interest to the industry. Apart from this service, the Panel is always ready to deal with any specific inquiry which an individual firm may care to submit to them.

Controls.—The question of controls has always exercised the Council. While it is admitted that, in the early post-war era a certain measure of control must be retained, the I.N.C. is anxious to return as quickly as possible to the old accepted system of unfettered private enterprise, and will take action to remove controls at the earliest possible opportunity, or at any rate to alleviate the burden of such controls that must be retained for a limited period in the national interest.

The Council desires to place on record their appreciation of the work which has been done by the staff at headquarters and for the ready assistance of the officers and the Committee members who have so willingly given of their time and energy to the work of the Confederation, often at very great personal inconvenience.

The meeting placed on record their lively appreciation of the long and valuable services of the retiring chairman, Mr. J. E. V. Jobson, who had occupied the chair since the formation of the I.N.C. in 1939. The whole industry owed him a deep debt of gratitude for his work, not only in initiating the organisation of the industry, but also for the time and energy he had unsparingly given over many years, and on many occasions, in the interests of his fellow ironfounders.

PROSPECTS FOR PRINCIPAL CAST METALS

(*Continued from page* 258.)

per sq. in. Some grey-iron crankshafts weigh 5 tons and are 22 ft. long. One company that has made thousands of crankshafts for one particular service has been informed of only two failures, and these were not associated with the material.

Damping

Years ago the lever mechanisms and understructures of scale mechanisms were grey-iron parts, but to-day the 200- and 250-ton scales used in heavy industry and for railway-wagon weighing have steel levers and mechanisms. Vibration is transmitted through the whole structure to the hardened 52,100 steel knife edges, vibrations enough to shift position of the knife edges and inject weighing errors. The damping property of grey iron would destroy vibration before it could reach the knife edges. Design of scale mechanisms must conform to specifications laid down by one of the national code-making bodies (American Association of Railways) and sometimes in their history they required either material properties beyond what engineers could find in their obsolete references on grey iron or their foundry sources were not sufficiently progressive in improving quality levels of the material compatible with increasing requirements. Transmission machinery, particularly gearing, is another application of grey iron where its damping property is of value in decreasing the noise level.

Grey Iron at Elevated Temperatures

Many years ago one of the national code-making bodies (Boiler Code Committee—A.S.M.E.) determined that grey iron should not be used at temperatures beyond 450 deg. F. in pressure-temperature applications. Within the past year this limitation has been increased to 650 deg. F.

Metallurgy

Those of us associated with the metallurgical profession know that such terms as ferrite, pearlite, aricular, martensite, austenite and carbide are used to describe the matrix of various types of steel which would include structural, manganese steel, tool steel, stainless, etc. All of these metallurgical terms are equally applicable and correctly applied to the many types of grey iron.

Development

Many large foundries have well-equipped research facilities directed toward producing increased quality in the material and toward making better component parts of the material. The research facilities of other organisations implement the foundry facilities. Within the past year the board of directors of the Grey Iron Founders' Society established cash awards for research work done in engineering schools throughout the country. An essential of this work is that all data developed be in measurable units that the engineer uses with other materials.

INSTITUTE OF BRITISH FOUNDRYMEN

SCOTTISH BRANCH ANNUAL MEETING

The annual general meeting of the Scottish Branch of the Institute of British Foundrymen was held on March 10. Extracts from the report of Mr. John Bell, hon. secretary, are printed below.

The opening meeting in October was easily the best attended meeting of the Branch during the past 23 years, and was, possibly, the best attended meeting it ever held. No fewer than 103 members and 30 visitors signed the register and there were possibly another 30 or more who did not sign, but who crowded into the room just in time for the start of the meeting. Taking the record of signatures only, and neglecting those who came in without signing the attendance books, the average attendance during the session was 92, of whom 73 were members and 19 were visitors. Of the members, ten were members of Council. For last session the average attendance was 64, 51 being members and 13 being visitors.

As a result of this influx of new life our membership has taken another step forward, and soon we shall be thinking of a 400 target in place of the 300 that eluded us for so long. It is interesting to note that many of these new members are young men seeking to find in the Institute a means of advancing their technical knowledge of the industry and who hope, with the knowledge gained, to graduate to better positions in it. It is hoped that nothing will happen to stop or reverse the influx of these young men, on whose practical knowledge the industry must one day depend. The membership now consists of:—Subscribing firms, 10; hon. and life members, 6; members, 108; associate members, 238; associates, 3; and students, 4; a total of 369, which shows an increase of 31.

There must be many of our associate members who joined as younger men, but who are now holding positions of higher authority and greater responsibility. This appeal is specially addressed to them.

The Branch has suffered losses through the death of three members. One of these was Mr. W. B. Davidson, of Arbroath, who for many years was our most northerly member. Mr. Davidson had been a member for a long time, was always keen to know of the progress made, and always regretted that distance prevented him being amongst us as much as he would have liked. A second one was Mr. Robert Scott, of Clarkston, Glasgow. He was known to quite a number of members, but did not take much active part in the affairs of the Branch. The third member was the best known of the three, Mr. James McArthur, of Motherwell, who was for many years a member of the Council, a senior vice-president of the Branch, and for a period represented it in the General Council.

Whilst membership is up to a record, arrears are also down to a record. The total is £23 less than a year ago, and for the first time there are no arrears further back than the year previous to the one under review. Leaving out the current year, of which there are ten months yet to go, the total arrears cover only 13 members and the total value only £16 16s. Nearly £500 has been received by way of subscriptions.

Honours

It is interesting to record that this session the "Oliver Stubbs" medal was awarded to a member of the Scottish Branch. The last award of this medal to a Scottish member was in 1936, when it was given to Mr. Frank Hudson. Now, eight years later, it has been awarded to Mr. W. Y. Buchanan, who, during those intervening years, has contributed willingly and unsparingly in an effort to find answers to many of the technical problems that have come up for discussion. No fewer than three Institute Diplomas have been awarded to members of our Branch. Two of these were to Mr. John Arnott and Mr. James McPheat for the outstanding Paper on "The Spectrographic Analysis of Cast Iron," which they presented to the annual meeting of the Institute in London in 1942. The third one goes to Mr. M. R. Hinchcliffe for his interesting Paper on "An Outline of Gravity Die Casting," read before this Branch on January 8, 1944.

During the session the question of the post-war training of foundry apprentices has engaged much attention, and in the various discussions on this subject the Council has been represented by Mr. Young, Mr. Marshall and the secretary. The President, Mr. Tyrie, has also taken his share and formed, with the others, a deputation to the Scottish Advisory Council on Education at St. Andrews House, Edinburgh.

The training of the future foundryman is one that must engage the serious attention of all members. Whatever problems the post-war world will throw up, it is certain that castings will still be necessary.

It is but right that members of the Branch and of the Institute should take their fair share in planning for these future conditions. Some of us seem to have been planning for a long time, and sometimes the older members begin to think they have little to show for it all. Possibly they have worked better than they knew. Possibly the young men crowding into the meetings, reading Papers, and leaving one almost breathless with recitals of the almost unbelievable things they have done is the answer to doubtings and earlier misgivings.

Election of Officers

The report having been adopted, the following were elected office-bearers for the next session:—President, Mr. Alex. Marshall; Vice-Presidents, Capt. Tom Shanks and Mr. R. O. Paterson; members of Council, Mr. James Arnott, Mr. Andrew Pearson and Mr. John R. Wilson; representatives to General Council, Mr. R. Ballantine, Mr. W. Y. Buchanan, Mr. T. Tyrie, B.Sc., and Mr. D. H. Young; representative to Technical Committee, Mr. John Arnott, F.I.C.; hon. secretary, Mr. John Bell.

It is of interest to note that Mr. Bell now starts on his 23rd term as hon. secretary of the Branch.

Following the annual meeting, Mr. A. H. Rathbone presented a Paper on "The Reclamation of Aluminium Alloys."

METAL PRICE CHANGES

By "ONLOOKER"

Among the major differences between this war and the last has been the control exercised over commodity prices in a manner which has prevented the excessive increases in value seen during the years 1914-18, but it is obvious that, if inflation is to be avoided, it may be necessary to maintain many of these controls for a longish period after hostilities have ceased. While this applies to a great many commodities in common use, and, in fact, to nearly everything, there are, nevertheless, exceptions, among which may be cited the non-ferrous metals, with the exception of tin. During the past years of conflict the world's capacity to produce certain metals has been greatly expanded, and among these may be mentioned aluminium and magnesium.

It is inconceivable that under peacetime conditions this capacity can be more than partially exploited, and we may therefore assume with justification that in the case of aluminium and magnesium the danger to the price structure on control being withdrawn would arise in the direction of a fall rather than a rise. Aluminium has recently been the subject of a price reduction of £25 in this country, but the American quotation is unchanged; virtually the two markets are about in alignment. Magnesium is overpriced in our market compared with the States, and may be the next to come down.

Aluminium Supplies

Here, then, is an example of one of the metals (aluminium) which, in the event of price control being removed, would almost certainly fall sharply even from its revised quotation of £85, since there is more than enough for all likely needs. Production costs, too, in the United States and Canada in the post-war period are expected to be such as to allow of a further paring down of the selling price to the neighbourhood of £60, but at that level British producers could not compete without a subsidy to help them. This will constitute a problem for the Government, since on security grounds domestic production ought to be maintained. Now that the ice has been broken and a change has been made in the fixed price of one of the chief strategic metals, other alterations may follow. Actually there was another metal reduced in value recently, and that was antimony at the beginning of the year, so that, one way and another, there is certainly a loosening-up process afoot. This may spread, for the fall in aluminium exercises a downward thrust on copper, an influence not calculated to be in evidence, however, so long as demand for the latter metal continues at such a high rate.

The price influence which one commodity exercises upon another is a well-known phenomenon in commerce when a condition of possible competition on account of alternative usage exists, and it is impossible for values to be out of a proper proportion for long. Aluminium and copper, for example, are com-

(*Continued at foot of next column.*)

STEEL FOUNDRY PROBLEMS

The Iron and Steel Institute has now published its First Report of the Foundry Practice Sub-committee of the Steel Castings Research Committee. The findings are summarised in the following statement.

The Foundry Practice Sub-committee was formed to carry out practical investigations into problems encountered in the steel foundry. Part I of this Report records their work on the running and risering of simple shapes used as 4-in., 6-in. and 9-in. cube castings, and castings 6 in. square by 12 in., 18 in., and 24 in. long. The effectiveness of various types of feeder heads normally used in steel foundries is illustrated by a large number of sawn sections of the experimental castings. The disadvantages entailed in using narrow heads which freeze prematurely, and the advantages of wider heads, insulated heads and the use of mould material which promotes differential solidification are illustrated. The establishment of definite principles to be applied to steel castings will help to remove some of the uncertainties which constantly confront the technical staffs of steel foundries.

The pioneer work in developing the so-called "whirlgate" head method of feeding steel castings and recent examples of the application of this type of head and of the "atmospheric" head are described and illustrated in Part 2. Foundry trials comparing the different types of feeding compound used on the fluid steel as it rises into the heads of steel castings are summarised in Part 3. In Part 4 experiments designed to provide a numerical index of the tendency of different steels to hot tears in the mould are reported, and attention is drawn to the fact that the degree of hot-tearing in a particular design can be minimised or often eliminated by using steel with a low sulphur content.

In Part 5 some of the wartime activities of the Sub-committee are set out, and some fundamental casting problems are mentioned in Part 6. With a return to more normal conditions attention will be devoted to further research under practical foundry conditions. The future progress of the steel-castings industry depends on the co-operation of the foundry executives, who have already given so much of their time and experience, and on the generosity of individual manufacturers, who have carried out these practical experiments at their own expense.

(*Continued from previous column.*)

petitive in the electrical field and in certain other directions, so that it follows they must bear a right price relationship to each other. Aluminium being by volume about one-third the weight of copper, it is evident that the latter must be marketed at a price which is well below that of the lighter metal. In the past this has always obtained, but in the immediate future, with a world-wide demand for both capital and consumer goods to fill the vacuum created by the war, the situation may be such that buyers will not be too anxious to make sure that they are getting something which is not over-priced.

WELDING OF ALUMINIUM BRONZE

In an article on "The Welding of Aluminium Bronze," which was published in a recent issue of the "Shipbuilder and Marine Engine-Builder," Mr. C. H. Meigh, of Meigh High Tensile Alloys, Limited, gives the following hints as to the rehabilitation of castings:—

Repairing Castings

In repairing aluminium bronze castings, it is inadvisable to begin by chamfering edges, except where the depth is too great to permit the arc to be struck at the bottom of the cavity. It should be remembered that the extent of a defect is not always apparent on the surface. For example, the surface defect may resemble a crack or a "cold-shut," the defect may be skin deep, or it may go to some depth before terminating in a cavity. Another type of defect is that of porosity, which may be purely superficial or occupy a zone in depth.

In any case, the job should first be "sounded" by striking an arc and running it over the defect so as to melt the surface metal. If the defect is superficial, it will disappear when the arc is removed; but if it is deep, a hollow will be formed which will have to be filled by added metal. When a defect extends completely through the entire thickness of a thin casting (say ¼ in. thick), one side should be welded to a depth of, say, ¼ in. or ⅜ in., and the operation should then be repeated from the opposite side, so that the weld zones overlap to produce perfect continuity of structure.

An alternative, but more difficult, method is to support the bottom of the molten bath by firebrick or other refractory material, and, in this case, it may be necessary to chamfer thick material before welding. In making butt welds in thin material, it is essential to support the weld, and, for a really neat job, the arc must be passed over the portion of the weld that has been against the support. Again, chamfering is necessary only where the thickness of the work exceeds, say, ½ in.

Fluxing

A suitable welding flux consists of 60 per cent. cryolite and 40 per cent. sodium fluoride. The melting point of cryolite is 1,000 and that of aluminium bronze 1,080 deg. C. The melting point of sodium fluoride is 980 to 990 deg. C., but a mixture of cryolite and sodium fluoride, in the proportions mentioned, melts at a slightly lower temperature, and, when combined with aluminium oxide, the compound melts at a little over 800 deg. C.

These figures show that, although either cryolite or sodium fluoride may be used separately as a flux, the danger of such fluxes being incorporated in the weld is very considerably reduced by the use of a mixture of the two. The flux, which is in powder form, may be used by sprinkling a small quantity on to the job before striking the arc, or by dipping either the hot carbon or the hot rod into the flux, the drops being allowed to fall on to the weld. The choice of method

(*Continued at foot of next column.*)

SAND TEST SPECIMEN DRYERS

Sand specimen dryers are now available in America for both the 2-in. and the 1¼-in dia. sand specimens. These dryers will be found useful for holding the laboratory sand specimens to size during the drying

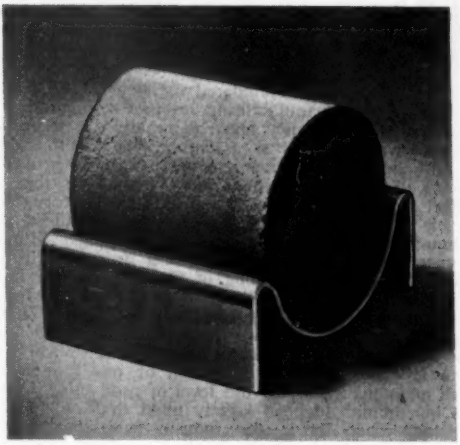

FIG. 1.—A SIMPLE FORM OF SAND SPECIMEN DRYER.

or baking periods. This is particularly so for low-strength core specimens. The dryer, as illustrated, is formed of $\frac{1}{16}$-in. thick brass, and has been designed by the Harry W. Dietert Company, 9330, Roselawn Avenue, Detroit, 4, Michigan, U.S.A.

"FOUNDRY PRACTICE," the house organ of Foundry Services, Limited, of Long Acre, Nechells, Birmingham, 7, in its January-February issue, contains articles on "Materials for Moulds and Cores Used in Die-making," "Repairing Light Alloy Castings," and "Moulding Hand Wheels."

(*Continued from previous column.*)

must depend largely on the type of the work to be done.

If care be not taken, slag may be formed by a mixture of spent flux and oxides, and, in these circumstances, further application of flux will not always eliminate such slag. In such cases it should then be chipped or brushed off before the welding operation is continued, and the weld should then be completed as quickly as possible, because the metal oxidises instantaneously when molten, and the oxide which has to be removed by flux represents a loss of aluminium and a weakening of the tensile properties of the weld.

FROM WAR TO PEACE IN STEEL INDUSTRY

In his speech at the annual meeting of the Lancashire Steel Corporation, Limited, recently, Mr. John E. James, chairman and managing director, said that the cessation of development for nearly six years in the iron and steel industry in this country, unavoidable as it had been, had given considerable advantage to other countries which had been able to pursue their development unhindered or even to add modern units to their manufacturing resources. This loss of comparative efficiency must be rapidly overtaken, and as we were credited as a nation with resourcefulness and adaptability, a view which the war had proved to be well-founded, he had every confidence that the steel industry would be able to deal satisfactorily with such a situation. He was not one of those who thought that this country should be content with the capacity for making iron and steel products which it possessed at the beginning of the war. The industry technically was, he believed, in much better shape in 1939 than it had been for many years, but he should not like to think that we had then reached the limits of our productivity either in degree or in kind. None the less, not only the expansion of our output, but the maintenance of the old level of production would, in his opinion, depend largely upon the raw material factor, especially if the industry was to be able successfully to export its finished products.

The price of coal and the quality of the iron ore which we used in our furnaces were inseparable factors in this problem of raw material supplies. Coal was the first and steel the second link in the chain of processes which finally resulted in many of this country's exports, and it was earnestly to be hoped that out of the many panaceas for the coal industry which were now being advocated, means would be found for supplying sufficient coal to the steel industry at the right price.

A further question, and one which was at present receiving the attention of the industry, was the possibility of centralising the manufacture of different iron and steel products in respectively suitable areas throughout the country.

PERSONAL

MR. R. GILLESPIE and MR. R. DOUGLAS, both of whom started their working life as boys with the firm, have been appointed directors of Dobson & Barlow, Limited, textile engineers, founders, etc., of Bolton.

MR. M. BURNINGHAM has been appointed chairman and managing director of Keith Blackman, Limited, engineers, etc., of Tottenham, London, N.17, in succession to the late Mr. George Keith, who died recently. MR. A. L. AYTON has been appointed secretary of the company, and MR. E. E. TAVENER industrial gas engineer.

Wills

CAMPBELL, SIR JOHN, of Radlett, Herts, chairman of the International Tin Committee £22,155

LLANELLY'S POST-WAR PROSPECTS

Representatives of the Llanelly Borough Council have recently met Mr. E. Lever, chairman of Richard Thomas & Baldwins, Limited, and expressed the town's uneasiness at the declaration that a cold-reduction plant in connection with the proposed strip mill would be established in Llanelly only if there were no insurmountable difficulties present. Mr. Lever stated that, so far as the technical situation was concerned, the matter had been solved, and that the economical factor—without his binding his board of directors—might also lend itself to a solution. The deputation later met the directors of the Bynea Steel Works, Limited, who outlined their programme, which involved very substantial capital expenditure in the provision of new plant.

The Corporation's representatives then had an interview with Mr. Hugh Dalton, President of the Board of Trade, who was supplied with particulars of the number of the personnel who would be unemployed if the present factories only were operating after the war. The representatives were given to understand that the Nuffield factory near Llanelly would continue in connection with peacetime production, while the President of the Board of Trade intimated that in some form or other the Pembrey factory would continue to operate after the cessation of hostilities.

ALLOCATION OF GOVERNMENT FACTORIES

The President of the Board of Trade has announced that 19 Government factories have already been allocated for peaceime production. The total space thus allocated amounts to 7,000,000 sq. ft., and this should provide employment for more than 50,000 workers. Up to the end of February the Board of Trade had received from industrialists approximately 2,700 applications for space in Government factories, totalling more than 100,000,000 sq. ft.

Among the allocations so far made are the following:—

Llanelly, Morris Motors, Limited, motor cars; Cwmbran, Newport, Joseph Lucas, Limited, motor equipment; Bristol, Bristol Aeroplane Company, Limited, aero engines; Solihull, Rover Company, Limited, motor-cars; Chester, Brookhirst Switchgear, Limited, switchgear; Coventry, Standard Motor Company, Limited, motor-cars; Coventry, Rootes Securities, Limited, motor-cars; Peterborough, British Thomson-Houston Company, Limited, refrigerators; Doncaster, International Harvester Company of Great Britain, Limited, farm machinery; Camborne, Holman Bros., Limited, mining equipment; Oldham, Parkinson Stove Company, Limited, gas appliances; Armley, Leeds, Wilsons and Mathiesons, Limited, gas stoves; Workington, C. Corner & Company, Limited, gas stoves.

SIR GEORGE C. GODFREY, chairman of Foster, Yates & Thom, Limited, of Blackburn, has died, aged 73.

The High-Quality Iron for High-Duty Castings.

Made in seven standard grades or to individual requirements, this iron has a close grain structure and fine graphitic carbon content. It replaces Hematite, and tones up high phosphorus irons.

We also make Dale Refined Malleable Iron to any required specification.

NEWS IN BRIEF

THE MANCHESTER ADDRESS of Ferodo, Limited, is now 53-55, Fennel Street, Manchester, 4.

A FACTORY AT Coatbridge is being taken over by G. & J. Weir, Limited, for the making of steel houses.

AS FROM APRIL 3, the registered office of Beralt Tin & Wolfram, Limited, will be at 8, Great Winchester Street, London, E.C.2.

BRITISH CYCLE MAKERS aim at making half a million new bicycles for export and half a million for this country during the present year.

THE BROMFORD IRON COMPANY, LIMITED, is being wound up voluntarily. Mr. J. A. Evans, 38, Great Charles Street, Birmingham, is the liquidator.

HINDSFORD FOUNDRY COMPANY, LIMITED, is being wound up voluntarily. Mr. S. T. Meadow, St. Clements Road, Wigan, Lancs, is the liquidator.

THE DIRECTORS OF Sidney Flavel & Company, Limited, Eagle Foundry, Leamington, have applied to the Treasury for consent to an issue of new shares. The additional capital is needed to undertake the company's post-war programme.

REPORTS FROM RUSSIA say that the first section of the Krasny Profintern engineering plant at Krasnoparsk, construction of which was begun during the war, is in production. The plant will build locomotives, cranes, and other machinery.

THE PARK GATE IRON & STEEL COMPANY, LIMITED, are preparing plans to reinstate in the firm's employment employees who are in the Services, including those disabled. It is estimated that one-fifth of the company's workmen are in the Services at present.

THE U.S. WAR PRODUCTION BOARD has appointed an Emergency Committee on Steel Problems, to review the entire steel supply and demand situation for the second and succeeding quarters of this year, with a view to making recommendations to assure that all essential requirements will be met.

FULLY-EQUIPPED WORKS at Chapelhall, near Airdrie, are being taken over by Vactric, Limited, engineers. Arrangements have also been completed by the company for the erection within 12 months of another factory. The location in Scotland has been selected with particular regard to export trade.

IN ANNOUNCING the result of their offer to exchange ten A.E.I. 8 per cent. preference shares for every eleven British Thomson-Houston 7 per cent. preference shares, the directors of Associated Electrical Industries, Limited, state that over 90 per cent. acceptances have been received and the offer is now declared binding.

SPEAKING AT BRADFORD on March 16, Mr. George W. Lucas, president of the Motor Agents' Association, said that industrial trade associations, in his view, must form the link between industry and trade and the State. They would grow both in compass and authority as the inevitable result of the vital need for greater overall efficiency in British industry.

SIR JOHN WARDLAW-MILNE, M.P., chairman of the Select Committee on National Expenditure, speaking at Guildford recently, said the question at the next election would be quite a simple one, however much the Socialists tried to camouflage it: "Do we want a continuance of State control and extended nationalisation, or do we want to promote private enterprise and individuality?" As soon as possible, he said, let us get rid of controls—although some must remain for a short time—and let the planners take care they do not plan us out of existence altogether.

IN ORDER TO ASSIST in regaining the export markets for British oil engines, a new company, British Oil Engines (Export), Limited, has now taken over the export sales of engines manufactured by Petters, Limited, Mirrlees, Bickerton & Day, Limited, J. & H. McLaren, Limited, Oil Engines (Coventry), Limited, and Fielding & Platt, Limited. Mr. F. S. Mitman is chairman of the company and Capt. R. C. Petter has been appointed managing director. Mr. A. P. Good, Mr. A. P. Quarrell, Mr. S. A. Lane and Mr. F. A. Vaughan are also on the board. Temporary offices have been opened at 27, Gilbert Street, London, W.1.

FORTHCOMING EVENTS

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

APRIL 12.

Institute of Metals:—Joint meeting between the London Local Section and the London Section of the Society of Chemical Industry. At the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1, at 7 p.m.

APRIL 20.

Keighley Association of Engineers:—"Recent Developments in Powder Metallurgy," by Dr. Rowell (Imperial Chemical Industries, Limited). At Devonshire Buildings, Devonshire Street, Keighley, at 7.30 p.m.

Institute of British Foundrymen

APRIL 7.

Bristol and West of England Branch:—Annual general meeting and whist drive.

Wales and Monmouth Branch:—Works visit to the Tubal Cain Foundry and Engineering Works, Limited, Cardiff, at 2.45 p.m. Followed by a lecture at the works on "Phosphor-bronze Worm Wheel Blanks," by A. Hopwood.

APRIL 14.

Bristol and West of England Branch:—"Plaster and Plastic Patternmaking and Low Melting Point Metals," by H. Plucknett. At the Technical College, Brunswick Road, Gloucester, at 3 p.m.

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Bedlington, April 7—4-in. cast-iron water mains and specials, for the Bedlington Urban District Council. Mr. W. Hall, engineer and surveyor, Council Offices, Bedlington.

Glasgow, April 7—Iron castings, etc., for 12 months from June 1, for the Town Council. The Office of Public Works (Room 81), City Chambers, Glasgow.

Design by Victor Reinganum

MOSAICS OF STEEL

NUMBER ONE

Cast iron as an engineering material has found fresh favour with the advent of high duty irons. The materials, in strength, soundness and physical properties, are a great improvement on the best cast iron of a generation ago. Workington irons enjoy unusual confidence amongst foundry men, particularly for special duties. The unique conditions existing at Workington contribute to the production of superior irons. The pure hematite ores are mined locally and, with rigid control throughout all processes, result in a product having a low sulphur and phosphorus content. All iron manufactured is machine cast and is free from sand and awkward pieces. Refined irons are also made from virgin metal without remelting or the addition of scrap. They are therefore eminently suitable for the production of malleable iron and special castings. Workington pig iron is used as the basis of the finest acid steels.

THE UNITED STEEL COMPANIES LTD

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WORKINGTON IRON & STEEL CO., WORKINGTON
UNITED COKE & CHEMICALS CO. LTD., CUMBERLAND

THE ROTHERVALE COLLIERIES, TREETON
THE SHEFFIELD COAL CO. LTD., TREETON
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USP. 45

COMPANY RESULTS

(Figures for previous year in brackets.)

Blythe Colour Works—Dividend of 30% (5%).

Amalgamated Metal Corporation—Dividend of 3½% (same).

Thompson Bros. (Bilston)—Interim dividend of 7½% (same).

J. Samuel White—Interim dividend of 2½%, tax free (same).

Brown, Bayley's Steel Works—Interim dividend of 5%, tax free (same).

A. A. Jones & Shipman—Net profit for 1944, £16,600 (£12,473); dividend of 10% (same).

Sir William Arrol & Company—Dividend of 15% and bonus of 10%, making 25% (same).

Watford Electric & Manufacturing—Second interim dividend of 10% (same), making 15% (same).

Electrolytic Zinc Company of Australasia—Interim dividend of 4% on the preference and ordinary shares.

Radiation—Income from subsidiaries for 1944, less tax, £147,489 (£15,0239); dividend of 10% (same); forward, £158,623 (£155,855).

Steetley Company—Trading profit for 1944, after war damage and contingencies, £107,374 (£111,360); final dividend of 6%, making 10% (same); forward, £24,028 (£13,201).

Arnott & Harrison—Net profit to June 30, 1944, after depreciation, taxation and war damage premiums, £22,252 (£19,225); dividend of 20% (same); forward, £12,068 (£10,316).

John Baker & Bessemer—Surplus for 1944, after taxation, depreciation, etc., £25,500 (same); war damage insurance, £1,383 (£1,814); dividend of 10% (same); forward, £30,779 (£26,880).

Beralt Tin & Wolfram—Trading profit for 1944, £61,888 (£59,573); to reserve for taxation, £20,500 (£16,700); final dividend of 5%, making 10% (same); forward, £33,982 (£25,695).

Federated Foundries—Profit for 1944, depreciation and provision for taxation, £28,554 (£37,937); to additional depreciation reserve, £7,500 (£5,000); written off goodwill, £5,000; forward, £43,166 (£34,917).

Ingall, Parsons, Clive—Net profit to September 30, 1944, £9,808 (£8,763); to war contingency reserve, £1,000 (£4,000); to general reserve, £4,000 (nil); dividend of 10% (same) on the ordinary and deferred shares; forward, £12,867 (£13,292).

Josiah Parkes & Sons—Net trading profit for 1944, £29,913 (£38,024); to A.R.P., 171 (£1,584); war damage, £339 (£564); tax, £14,646 (£21,768); net profit, £14,756 (£14,108); dividend of 10%, £7,500 (same); to reserve, £8,000 (£6,000); forward, £10,213 (£10,957).

P. & W. Maclellan—Net profit for 1944, after provision for taxation and contingencies, £52,997 (£57,560); debenture interest, £6,561 (same); depreciation, £10,000 (same); deferred repairs, £5,000 (£8,000); to reserve, £10,000 (same); dividend of 6% (same); forward, £8,970 (£8,053).

North Lonsdale Iron & Steel—Trading profit for the 14 months ending December 31, 1944, £11,369; dividend from the Whitehaven Hematite Iron & Steel Company, £3,298; to reserve for taxation, £5,000; written off land, furnaces, etc., £5,712; forward, £8,998 (£5,043).

Beans Industries—Profit for the year to November 30, 1944, after all charges, £40,385 (£40,207); war damage insurance, £1,283 (£2,133); to general reserve, £10,000 (nil); to contingencies reserve, £5,000 (£10,000); final dividend of 27½%, making 37½% (same); forward, £24,285 (£22,683).

Thos. Firth & John Brown—Profit for 1944, including E.P.T. recoverable, £568,113 (£578,853); net profit, £343,101 (£350,870); dividend of 5½%, making 10% (same), tax free; war damage contribution, £5,000 (£10,000); provision for contingencies, £100,000 (same); forward, £265,518 (£224,417).

Clayton Dewandre—Trading profit for 1944, after E.P.T., £80,113 (£85,339); to directors' fees, £1,100 (same); written off buildings, plant, etc., £16,933 (£19,971); income-tax, £26,350 (£22,350); to general reserve, £7,500 (same); interim dividend of 4%, £10,920 (same); final dividend of 6%, £16,380 (same); forward, £15,736 (£14,552).

Charles Clifford & Son—Trading profit for 1944, £57,896 (£73,903); to directors' fees, £1,500 (same); depreciation, £10,557 (£10,505); war damage insurance, £911 (£811); taxation, £26,500 (£42,548); net profit, £18.428 (£18,539); to war contingencies reserve, £5,000 (same); preference dividend, £900 (same); ordinary dividend of 17½%, £10,500 (same); to general reserve, £2,000 (same); forward, £24,958 (£24,930).

British Aluminium—Trading profit for 1944, including income from group companies and after provision for E.P.T., £1,027,438 (£1,045,112); total profit, £1,049,257 (£1,068,937); directors' fees, £31,250 (same); income-tax, £442,000 (£445,000); debenture service, £175,000 (same); depreciation, £75,000 (same); net profit, £326,007 (£342,687); to reserve, £125,000 (same); final dividend of 7% (same), making 10% (same); forward, £280,691 (£274,684).

ALUMINIUM DOMESTIC HOLLOW-WARE

The Treasury have made the Purchase Tax (Alteration of Rates) (No. 2) Order, 1945, the effect of which is to reduce to 16⅔ per cent. of the wholesale value the rate of purchase tax chargeable on aluminium hollow-ware of a kind used for domestic purposes. The reduced rate applies only to goods which are delivered on sale, or appropriated to retail trade or similar purposes, on or after March 31, or, in the case of imported goods, which are entered with the Customs or delivered from bonded warehouse for home consumption, as the case may be, on or after March 31.

THE DIRECTORS OF THE Brightside Foundry & Engineering Company, Limited, propose to amend the articles of association to provide for a minimum of three and a maximum of nine as the number of the board. The director's qualification is to be changed from £1,000 in shares to not fewer than 100 shares.